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SeaWiFS Lunar Calibration Methodology after Six Years on Orbit

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ABSTRACT

The SeaWiFS Project uses monthly lunar calibrations to monitor the on-orbit radiometric stability of SeaWiFS over the course of its mission. Ongoing analyses of the steadily increasing lunar calibration data set have led to improvements in the calibration methodology over time. The lunar measurements must be normalized to a common viewing geometry for the calibration time series to track the radiometric stability of the instrument. Corrections computed from the time and geometry of the observations include Sun–Moon and instrument–Moon distances, oversampling of the lunar image, and variations in the lunar phase angles. The Project has recently implemented a correction for lunar libration that is computed from regressions of the libration angles of the observations against the lunar radiances. Decaying exponential functions of time are fit to the geometry-corrected calibration time series. The observations for bands 1,2,and 5–8 are fit to two simultaneous exponential functions of time, while bands 3 and 4 are fit to single exponential functions of time. The corrections to the radiometric response of the instrument over time are the inverses of these fits. The lunar calibration methodology provides top-of-the-atmosphere radiances for SeaWiFS that are stable to better than 0.07% over the course of the mission, with residual time drifts that are smaller than -0.004% per thousand days. The resulting water-leaving radiances are stable to better than 0.7%, allowing the Project to implement a vicarious calibration of the water-leaving radiances that is independent of time. The calibration methodology presented here will be used to generate the calibration table for the fifth reprocessing of the SeaWiFS global ocean data set.

Keywords: SeaWiFS, ocean color, calibration, measurement trends

1. INTRODUCTION

SeaWiFS in an eight-band visible and near-infrared scanning radiometer designed to have high radiometric sensitivity over oceans without saturating over bright clouds. The SeaWiFS bands are provided in Table 1. The on-orbit calibration strategy for the instrument uses monthly lunar calibrations to monitor the radiometric stability of the individual bands.

For each lunar calibration, the radiances observed by SeaWiFS are integrated over the lunar images. The time series used to monitor the radiometric stability of the instrument are these integrated radiances for each band, normalized by the integrated radiances of the first calibration. The uncorrected time series are shown in Fig. 1. Periodic signals in the time series arise from variations in the geometry of the observations from one lunar calibration to the next. In order to track the radiometric stability of the instrument, the measurements must be normalized to a common viewing geometry. Geometric corrections are computed and applied for the Sun–Moon and instrument–Moon distances, the oversampling of the lunar images in the along-track direction the phase angles of the observations, and the libration angles of the observations. The current implementations of these corrections for SeaWiFS are improvements on previous geometry correction methodologies.[1,2]

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